#### **NEWSLETTER CARBODIN**



### SIMONA NERI, Project coordinator, eurecat

CARBODIN consortium is proud to summarize the project activities and present our final newsletter. After 27 months, we are glad to report that CARBODIN reached its overarching objective of improving car body shell manufacture through the possibilities offered by composite materials. I am delighted to have lead this project in the position of coordinator, as it brings together my interests in material optimisation and innovation, which is the focus of my current job.

CARBODIN has been brought on by a strong multidisciplinary Consortium, made of 14 partners from 7 countries, committed not only to achieve CARBODIN's vision but also to maximise the project's impact. The active participation of the industries in this venture demonstrates the need for further research in this field and, thanks to the deep knowledge provided by the RTOs involved, the project allowed us to overcome some of the technical hurdles that the market is currently facing.

On behalf of the CARBODIN Project I would like to thank you all for being interested in its activities. Though the CARBODIN journey is at the end, I recommend you stay tuned on our website and social media if you would like to know more about the further development of our innovations and technologies.

Finally, with this publication we remind you that the project webpage and the related social profiles will remain online and will continue to provide updates on the project participation in international conferences. If you are interested in the evolution of CARBODIN activities,

# CAR BODY SHELL DOORS AND INTERIORS

"This project has received funding from the Shift2Rail Joint Undertaking (JU) under grant agreement No 881814. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Shift2Rail JU members other than the Union".



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CARBODIN "Car Body Shells, Doors and Interiors" is a 27-month project, funded by the Shift2Rail JU under the European Union Horizon 2020 Research and innovation programme (Grant Agreement No. 881814).

CARBODIN project answers to the challenges identified in the Shift2Rail Open Call "S2R-OC-IPI-01-2019: Advanced Car body shells for railways and light material and innovative doors and train modularity". The call is inserted on Shift2Rail Innovation Programme 1 -IPI "Cost-efficient and Reliable Trains, including high capacity trains and high speed trains" of the Shift2Rail Master Plan, and is related to the topics of Advanced Car body shells for railways and light material and innovative doors and train modularity.

The project aims at ensuring the success of the European rail system through costefficient passenger trains with high capability and reliability, low weight and high energy efficiency. CARBODIN is composed of three building Blocks, and sought to provide a first step towards the passengers train of the future by means of improved car body shell manufacture based on the new possibilities offered by composite materials.



Best regards and enjoy the read.

#### NEWSLETTER CARBODIN



With Block 1 "Car body shell", CARBODIN aimed at improving car body shell manufacture by exploring the possibilities offered by composite materials. The project researched the cost-efficiency and reliability of composite manufacturing technologies to dismantle the costs barrier preventing market introduction of composite technologies.

The project activities developed a modular tooling able to manufacture a wide range of composite parts of varying size. In addition, the process successfully combined different production techniques, automation concepts, co-cured and co-bonded composite parts and multi-material integrated joints and inserts. Besides, predictive maintenance could be reinforced by testing intelligent sensor nodes.

The employment of composite materials was also at the core of CARBODIN Block 2 "Doors".

CARBODIN investigated the cost-efficiency and reliability of composite manufacturing technologies applied to the context of regional train doors. The project did focus on the development of modular tools to reduce the cost of production of composite parts of similar geometry. Moreover, CARBODIN developed technologies to improve passenger comfort in the vicinity of the doors, ensuring thermal and acoustic insulation, and developed an accessibility ramp and gap filler validated through accessibility tests.

Lastly, as a result of research undertaken in Block 3 "Interiors", CARBODIN developed modular and aesthetic interior designs and layouts, characterised by low cost and a rapid uptake. The project also identified new human-machine interactions for future cabins and analysed the possibility of integrating low voltage circuits in side wall panels, to increase reliability and reduce overall weight.

# **ACTIVITIES:**

Though the COVID-19 pandemic did affect the development of the project, the Consortium successfully carried out the proposed activities. Amongst its activities, the Consortium advanced the state of the art regarding Structural Health Monitoring sysytems, through the development of a sensor networks able to remotely detect early stage and developing faults in composite materials, so to implement the best maintenance approaches. This development will allow minimising maintenance costs of future carbodies without compromises for passenger safety.



LAYOUT OF THE SENSOR MONITORING SYSTEM ACROSS THE CARBODY

On September 2021, CARBODIN validated its innovative accessibility ramp. This device employs artificial intelligence in monitoring the sorrounding environment and is able to detect the height and position of the platform. Through the built-in sensors, the ramp automatically deploys either as a Ramp. Step or Bridge, depending on the situation and without any required inputs from the passengers.

This ramp represents a great innovation for the sector, ensuring that passengers with limited mobility will have the possibility to board trains autonomously.







ROBOT EMPLOYED FOR AUTOMATED TRIMMING OF COMPONENTS IN COMPOSITE MATERIAL



#### CARBODIN ACCESSIBILITY RAMP DURING VALIDATION

# **ACTIVITIES:**

CARBODIN also improved the state of the art regarding multi-material application in composite materials applied to railways. Through specific analysis and experiment, CARBODIN partners successfully integrated 3D printed plastic inserts in a composite carbody sidewall. This innovative approach opens the sector to future light, modular, rapidly assemblable composite carbody components.



CARBODIN UCCESSFULLY EMBEDDED 3D PRINTED COMPONENTS IN A COMPOSITE CARBODY SIDEWALL

MORE CARBODIN ACTIVITIES CAN BE FOUND IN ITS SECOND YEAR REPORT, AVAILABLE: WWW.CARBODIN.EU WWW.ZENODO.ORG/COMMUNITIES/CARBODIN/

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Anaptyxis (CERTH), Greece Asociación de Investigación Metalúrgica del Noroeste (AIMEN), Spain Rheinisch-Westfälische Technische Hochschule Aachen (RWTH), Germany Universita Degli Studi di Roma la Sapienza (DICEA), Italy Université Polytechnique Hauts-de-France (UPHF), France EURNEX, e.V. Germany The International Union of Railways (UIC), France Vvzkumny Ustav Zeleznicni, AS (VUZ), Czech Republic Chinesisch-Deutsches Forschungs- und Entwicklungszentrum für Bahn- und Verkehrstechnik Dresden GmbH. (CG RAIL). Germany Forster System-Montage-Technik GmbH (SMT), Germany MASATS, S.A., Spain ENDEGO, Poland

Ethniko Kentro Erevnas Kai Technologikis

### PAPERS PUBLISHED:

Throughout its activities, CARBODIN published articles in several international journals and conferences, on topics such as low-cost and low-power sensor units, acousto-ultrasonic investigation of defects, human-machine interfaces and structural health monitoring. These papers and more publications from the consortium can be found on the project website and on the Zenodo community at <a href="https://zenodo.org/communities/carbodin/">https://zenodo.org/communities/carbodin/</a>

#### VIDEOS

In October 2021, CARBODIN consortium was proud to share its project video presentation. The video features some of the project results and explains how its three Blocks worked toghether to advance the state of the art in railway carbodies. Feel free to check it out at this link: https://carbodin.eu/2021/10/04/carbodin-video/

Moreover, the project is committed to releasing additional videos presenting the results of the project, feel free to watch them at this link, always updated: https://carbodin.eu/2022/02/24/carbodin-videos/

# CARBODIN FINAL CONFERENCE

We were pleased to hold the Final CARBODIN Conference on the 24th and 25th of February 2022 online. It was the prefect occasion to reunite the consortium composed of representatives from academia and industry. Nevertheless, it was not only an event to look back to what CARBODIN accomplished but rather to look ahead, identify the most promising routes for the employment of CARBODIN innovations and detect research areas that further activities might need to focus on. We would like to thank all participants for attending the Final Conference and for contributing in making CARBODIN a success.



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